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FITZPATRICK CELLA HARPER & SCINTO
30 ROCKEFELLER PLAZA
NEW YORK, NY 10112

| EXAMINER |
|---|
| LAROSE, COLIN M |

| ART UNIT | PAPER NUMBER |
|---|---|
| 2623 | |

DATE MAILED: 01/25/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 09/410,737 | LE ET AL. | |
| | Examiner | Art Unit | |
| | Colin M. LaRose | 2623 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on 23 August 2004.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) 1-67 is/are pending in the application.

4a) Of the above claim(s) 1-9,25-29,48-50,53,57-59 and 62 is/are withdrawn from consideration.

5)☒ Claim(s) 20-24,30-34,46,47,54,56,63,65 and 67 is/are allowed.

6)☒ Claim(s) 10-12,15-19,35,39,40,43,45,51,52,55,60,61 and 64 is/are rejected.

7)☒ Claim(s) 13,14,36-38,41,42,44 and 66 is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

## DETAILED ACTION

### *Arguments and Amendments*

1. Applicant's amendments and/or arguments filed 23 August 2004, have been entered and made of record.

### *Response to Amendments and Arguments*

2. Applicant has amended claims 10, 12, 35, 51, 52, 55, 60, 61, and 64 to denote that only less than the total number of bordering pixels is considered when growing regions from seeds. In contrast, Ikonomakis discloses that all neighboring pixels are considered when growing pixel (see column 2, page 299, wherein all 8-connected neighbors to each seed pixel are considered).

U.S. Patent 5,734,736 by Palmer et al. has been applied below to cure this deficiency in Ikonomakis. As shown in figure 6, Palmer considers only four of the 8-connected neighbors of a seed pixel for growing regions to create a segmented image. This teaching by Palmer shows that it was conventional to consider less than the total number of border pixels when growing regions, and that considering less than the total number achieves substantially the same results as considering all 8-connected neighboring pixels.

### *Claim Rejections - 35 USC § 103*

3. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

4. Claims 10-12, 15-18, 35, 39, 40, 43, 51, 52, 55, 60, 61, and 64 are rejected under 35 U.S.C. 103(a) as being unpatentable over "Region Growing and Region Merging Image

Segmentation" by Ikonomakis et al. ("Ikonomakis") in view of "Seeded Region Growing" by Adams et al. ("Adams") and U.S. Patent 5,734,736 by Palmer et al. ("Palmer").

Regarding claims 10, 35, 51, 55, 60, and 64 Ikonomakis discloses a method of segmenting an image comprising:

allocating pixels as seeds (column 2, page 299, lines 1+: start with a set of seed pixels);

growing regions from the seeds so as to segment the image into regions (column 2, page 299, lines 2+: grow regions from the seeds),

wherein a number of pixels that border the regions are considered, the number being smaller than a total number of pixels that borders the regions (column 2, page 299, lines 7+: seed pixel is compared to its 8 neighbors, which, as explained above, comprises a smaller subset of neighboring pixels),

and the considered pixel that is most similar in a property to a region bordered by the considered pixel is appended to the region to form an expanded region and the property of <u>the appended pixel</u> is updated (column 2, page 299, lines 8+: border pixels that satisfy a similarity function (including the most similar pixel) are appended to the region and changed to the seed pixel value) and said growing step is repeated until no pixels bordering the regions are available (column 2, page 299, lines 22+: growing step is repeated until no border pixels are left).

Ikonomakis does not disclose updating the property of the <u>expanded region</u>, as claimed.

Adams discloses a system for segmenting an image by seeded region growing that is similar to that of Ikonomakis. Adams, like Ikonomakis, places seeds in the image and then grows homogeneous regions based on those seeds. However, whereas Ikonomakis teaches appending a pixel to a region, and then simply changing the value of the appended pixel to coincide with the

value of the region, Adams teaches appending a pixel to a region, and then using the mean of the expanded region for comparison to potential appended pixels (page 642, columns 1 and 2). That is, Adams does not change the value of the appended pixel so that it (as well as all of the pixels in the region) has the same value as the seed pixel, as taught by Ikonomakis. Rather, Adams simply appends a pixel a region when the value of the pixel is sufficiently close to the mean of the region. Then, the updated mean of the region (including the appended pixel) is calculated and compared to the value of the current border pixels for determining whether a pixel of interest should be appended. See equation (1), page 642.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Ikonomakis by Adams to achieve the claimed invention by utilizing Adams' method for appending pixels so as to update the property of the expanded regions (viz. appending pixels to regions without changing their [the appended pixels'] values, and then computing the updated mean of the expanded region for comparison), since Adams shows that comparing potentially appended pixels to the mean of an expanded region that includes previously appended pixels is a functionally equivalent alternative to the pixel-appending methods of Ikonomakis and produces desirable segmentation results, as noted by Adams in the $2^{nd}$ paragraph of column 2 of page 641.

Ikonomakis also does not disclose that <u>only</u> less than the total number of bordering pixels is considered when growing regions from seeds. Rather, Ikonomakis discloses that all neighboring pixels are considered when growing pixel (see column 2, page 299, wherein all 8-connected neighbors to each seed pixel are considered).

Palmer discloses a system that involves examining pixels bordering a seed pixel for the purposes of region growing. As shown in figure 6, Palmer considers only four of the 8-connected

neighbors of a seed pixel for growing regions to create a segmented image. See also column 8, lines 1-30. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Ikonomakis by Palmer to consider only four of the 8-connected neighbors for growing regions since Palmer shows that it was conventional to consider less than the total number of border pixels and that considering less than the total number achieves substantially the same results as considering all 8-connected neighboring pixels.

Further regarding claims 35, 55 and 64, Ikonomakis discloses allocating/distributing pixels as seeds in those areas of the image as a function of the luminance of the pixels within those areas (column 2, page 299, lines 5-22: a first seed pixel produces a first region of homogeneity, then a second pixel outside of the first region is specified as a second seed pixel, and subsequently produces a second region of homogeneity different from the first region; thus the seed pixels are allocated as a function of the luminance of homogeneous areas), wherein fewer seeds are allocated to those areas of the image having pixels of homogeneous luminance (each region is allocated only one seed; therefore, areas of the image having pixels of homogeneous luminance (i.e. encompass only one region) are allocated fewer seeds than those regions that are not homogeneous (i.e. encompass more than one region) and wherein said seeds form growing regions (i.e. each subsequent seed forms a new growing region).

Regarding claims 11 and 39, Adams discloses said property is the grey-value (luminance) of the pixels, expressed as a mean grey value (see equation 1, page 642).

Regarding claims 12, 52 and 61, Ikonomakis discloses a method of segmenting an image into regions, the image comprising a plurality of pixels, comprising:

allocating pixels as seeds (as in claim 10);

growing regions from the seeds, wherein the growing comprises:

scanning a subset of pixels that border the growing regions, the number of pixels in the subset being smaller than the number of total border pixels, and determining for each border pixel, a value indicative of the similarity of a property of the scanned pixel and the corresponding property of a region that the border pixel borders (column 2, page 299, lines 7+: the eight pixels that border the seed pixel (which is in the growing region) are scanned and the similarity of the border pixels to the seed pixel in terms of luminance is determined by $|G-G_s|$);

selecting a pixel that is most similar in the property to the region that said border pixel borders (column 2, page 299, lines 27+: a selected border pixel is appended to the growing region if it has a minimal difference value (this includes the most similar border pixel));

appending the selected pixel to the region bordered by the selected pixel (column 2, page 299, lines 10+: pixel is assigned to the region);

calculating an updated property of the region that includes the appended pixel (column 2, page 299, lines 9+: the luminance value of an appended pixel(s) (which comprises the appended region) is changed to the seed pixel value); and

repeating the growing steps until there are no more border pixels (column 2, page 299, lines 23+: growing steps are repeated until no border pixels are left).

Ikonomakis does not expressly disclose generating a list of the border pixels and scanning the pixels of the generated list.

Adams discloses a similar region-growing method for segmenting images that comprises generating a sequentially sorted list, or SSL, which contains neighboring pixels of growing regions (column 2, page 642, lines 12+). Neighboring pixels are stored in the list according to their similarity measures. The list is scanned in a predetermined manner, and pixels are removed until the list is empty.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Ikonomakis by Adams to generate a list of border pixels and scan the pixels of the list as claimed since Adams shows that utilizing a linked list of pixel addresses facilitates the labeling of boundary pixels into the their corresponding regions.

Ikonomakis does not disclose updating the property of the region as a function of the prior region's property and the property of the appended pixel, as claimed.

Adams discloses a system for segmenting an image by seeded region growing that is similar to that of Ikonomakis. Adams, like Ikonomakis, places seeds in the image and then grows homogeneous regions based on those seeds. However, whereas Ikonomakis teaches appending a pixel to a region, and then simply changing the value of the appended pixel to coincide with the value of the region, Adams teaches appending a pixel to a region, and then using the mean of the expanded region for comparison to potential appended pixels (page 642, columns 1 and 2). That is, Adams does not change the value of the appended pixel so that it (as well as all of the pixels in the region) has the same value as the seed pixel, as taught by Ikonomakis. Rather, Adams simply appends a pixel a region when the value of the pixel is sufficiently close to the mean of the region. Then, the updated mean of the region (including the appended pixel) is calculated as a function of the mean of the previous region and the value of the appended pixel, and is then

compared to the value of the current border pixels for determining whether a pixel of interest should be appended. See equation (1), page 642.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Ikonomakis by Adams to achieve the claimed invention by utilizing Adams' method for appending pixels so as to update the property of the expanded regions as a function of the prior region's property and the property of the appended pixel (viz. appending pixels to regions without changing their [the appended pixels'] values, and then computing the updated mean of the expanded region for comparison), since Adams shows that comparing potentially appended pixels to the mean of an expanded region that includes previously appended pixels is a functionally equivalent alternative to the pixel-appending methods of Ikonomakis and produces desirable segmentation results, as noted by Adams in the 2nd paragraph of column 2 of page 641.

Ikonomakis also does not disclose that <u>only</u> less than the total number of bordering pixels is considered when growing regions from seeds. Rather, Ikonomakis discloses that all neighboring pixels are considered when growing pixel (see column 2, page 299, wherein all 8-connected neighbors to each seed pixel are considered).

Palmer discloses a system that involves examining pixels bordering a seed pixel for the purposes of region growing. As shown in figure 6, Palmer considers only four of the 8-connected neighbors of a seed pixel for growing regions to create a segmented image. See also column 8, lines 1-30. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Ikonomakis by Palmer to consider only four of the 8-connected neighbors for growing regions since Palmer shows that it was conventional to consider less than the total

number of border pixels and that considering less than the total number achieves substantially the same results as considering all 8-connected neighboring pixels.

Regarding claim 40, and Ikonomakis discloses a method of segmenting an image into regions, the image comprising a plurality of pixels, comprising:

growing regions from the seeds, wherein the growing comprises:

scanning a subset of pixels that border the growing regions, the number of pixels in the subset being smaller than the number of total border pixels, and determining for each border pixel, a value indicative of the similarity of a property of the scanned pixel and the corresponding property of a region that the border pixel borders (column 2, page 299, lines 7+: the eight pixels that border the seed pixel (which is in the growing region) are scanned and the similarity of the border pixels to the seed pixel in terms of luminance is determined by $|G-G_s|$);

selecting a pixel that has a minimum value (column 2, page 299, lines 27+: a selected border pixel is appended to the growing region if it has a minimal difference value (this includes the most similar border pixel));

appending the selected pixel to the region bordered by the selected pixel (column 2, page 299, lines 10+: pixel is assigned to the region);

calculating an updated property of the region that includes the appended pixel (column 2, page 299, lines 9+: the luminance value of an appended pixel(s) (which comprises the appended region) is changed to the seed pixel value); and

repeating the growing steps until there are no more border pixels (column 2, page 299, lines 23+: growing steps are repeated until no border pixels are left).

Ikonomakis does not expressly disclose generating a list of the border pixels and scanning the pixels of the generated list.

Adams discloses a similar region-growing method for segmenting images that comprises generating a sequentially sorted list, or SSL, which contains neighboring pixels of growing regions (column 2, page 642, lines 12+). Neighboring pixels are stored in the list according to their similarity measures. The list is scanned in a predetermined manner, and pixels are removed until the list is empty.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Ikonomakis by Adams to generate a list of border pixels and scan the pixels of the list as claimed since Adams shows that utilizing a linked list of pixel addresses facilitates the labeling of boundary pixels into the their corresponding regions.

Regarding claim 15, Adams discloses said property is the grey-value of the pixels, expressed as a mean grey value (see equation 1, page 642).

Regarding claim 16, Adams teaches the claimed similarity measure (equation 1, page 642).

Regarding claim 17, Ikonomakis discloses the said value is determined in accordance with a metric in color space (equation 1, page 300).

Regarding claim 18, Ikonomakis discloses merging the grown regions which have similarities (column 1, page 300, lines 21+: after growing, merging is done).

Regarding claim 43, Ikonomakis discloses merging neighboring regions as claimed (column 2, page 299, lines 21+).

5. Claims 19 and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ikonomakis, Adams, and Palmer, as applied to claims 18 and 43, and further in view of "Image Segmentation and Approximation Through Surface Type Labelling and Region Merging" by Lim et al. ("Lim").

Regarding claims 19 and 45, Ikonomakis discloses

determining for each pair of neighboring grown regions a clique function value representative of the similarity of said property of said pair of neighboring grown regions; and

merging a pair of regions to produce a merged region if the clique function is less than a predetermined threshold (column 1, page 300, lines 32+: homogeneity (clique) function between neighboring regions and a merging threshold is used to merge regions whose value is less than the threshold – this includes the selection of the regions with the smallest clique function value and the comparison of their clique values to the threshold to determine if the regions should be merged).

Ikonomakis does not expressly disclose updating the merged regions' clique functions.

Lim discloses a similar method for merging segmented regions. Lim teaches selecting the region with the lowest measure of dissimilarity and repeatedly merging each subsequent selected region on the condition that the measure of dissimilarity does not exceed an error threshold value (column 1, page 1381, paragraph 5). Also, when two regions are merged, the measures of dissimilarity between the new region and its neighbors are updated.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify the merging sub-steps of Ikonomakis by Lim to achieve the claimed invention since

Lim teaches that the claimed merging sub-steps have good performance, a lower approximation error, and a reduced processing time (column 2, page 1381, paragraph 1).

### *Allowable Subject Matter*

6. Claims 13, 14, 36-38, 41, 42, 44, and 66 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

7. Claims 20-24, 30-34, 46, 47, 54, 56, 63, 65, and 67 are allowable.

Regarding claims 14, 20, 42, 46, 56, and 65, neither Ikonomakis nor Adams discloses using, for scanning the list of pixels, a step size that is a function of the length of the list, as claimed.

### *Conclusion*

2. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37

CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Colin M. LaRose whose telephone number is (703) 306-3489. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amelia Au, can be reached on (703) 308-6604. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the TC 2600 Customer Service Office whose telephone number is (703) 306-0377.

CML
Group Art Unit 2623
20 January 2005

VIKKRAM BALI
PRIMARY EXAMINER